Electrocardiograph Abnormalities in Children With Lyme Meningitis

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Objective. The objective of the study was to estimate the prevalence of and identify risk factors for electrocardiographic (ECG) changes in children presenting with Lyme meningitis.

Design. This was a cross-sectional study.

Setting. The study was set in three large urban pediatric tertiary care centers.

Participants. Children who were diagnosed with Lyme meningitis and underwent ECG testing were included.

Outcome measure. The presence of an ECG abnormality associated with early-disseminated Lyme infection was the outcome measure.

Results. Multivariable logistic regression was used to identify factors independently associated with ECG abnormalities. ECG testing was performed in 103 (66%) of 157 children with Lyme meningitis. The median age of these children was 10.8 years; 68% were male. ECG abnormalities, identified in 34 (33%) subjects, included one or more of the following: atrioventricular block (n = 16; 16%), ST-T wave changes (n = 14; 14%), and prolongation of the corrected QT interval (n = 11; 11%). In multivariate analysis, age ≥13 years and fever for ≥5 days were independently associated with ECG abnormalities. The probability of ECG abnormalities was greater than 50% in those with fever for ≥5 days or age ≥13 years, and if a subject fulfilled both criteria, the probability of ECG abnormalities was 83% (95% confidence interval: 50%–96%).

Conclusions. Electrocardiographic abnormalities occur commonly in children with Lyme meningitis. While older children with prolonged fever were most likely to have such abnormalities, the clinical consequences of asymptomatic ECG abnormalities in children with Lyme meningitis are not known.

Key words. Carditis; Epidemiology; Electrocardiogram; Lyme Disease; Meningitis

Aseptic meningitis is a well-recognized manifestation of early-disseminated Lyme disease. Patients suspected of having Lyme meningitis undergo lumbar puncture and have serologic tests obtained to confirm the diagnosis. However, the extent to which testing should be performed to detect other serious manifestations of early disseminated infection such as carditis is not known. National consensus guidelines do not address whether routine electrocardiogram (ECG) testing should be performed in patients with Lyme meningitis [1, 2]. Defining the risk of cardiac involvement in patients with Lyme meningitis and identifying factors associated with increased risk would help physicians determine which patients warrant an ECG.

The most common cardiac abnormality in patients with Lyme disease is atrioventricular (AV) block [3–6], but prolonged corrected QT (QTc) interval, ST-T wave changes, depressed ventricular function, and cardiogenic shock also occur [7]. As children may be asymptomatic or unable to communicate their symptoms, cardiac manifestations of Lyme disease may be under-recognized. The prevalence of Lyme-associated carditis in children
hospitalized with early disseminated Lyme disease was 16%, occurring in 33 of 207 children [7]. In a Lyme disease referral clinic, ECG abnormalities were identified in 4 of 14 children with Lyme disease who had an ECG performed [8].

Few studies have examined cardiac complications occurring in children with Lyme meningitis. Of patients presenting in Denmark with neurologic manifestations of Lyme, none had typical signs of Lyme carditis, although routine ECG screening was not performed [9]. This prior study has limited implications for children in North America because most patients were adults, the most common presenting symptom was painful radiculitis, and the species of *Borrelia* and the prevalence of clinical manifestations differ from Europe to North America [10, 11]. In a cohort of children with early disseminated Lyme disease, 16 of 131 (12%) children with Lyme meningitis had carditis [7], suggesting that cardiac manifestations of Lyme disease are common among patients with Lyme meningitis in endemic regions of North America. The aims of this study were to determine the prevalence of and identify risk factors associated with electrocardiographic changes of Lyme carditis in children presenting with Lyme meningitis.

**METHODS**

**Study Design, Setting, and Study Population**

We performed a multicenter cross-sectional study of children with Lyme meningitis at 3 large urban pediatric tertiary care centers located in Lyme-endemic areas. The study period varied by center: Boston Children’s Hospital (January 1, 1996 to December 31, 2009), The Children’s Hospital of Philadelphia (January 1, 2003 to July 31, 2010), and Nemours/ Alfred I. duPont Hospital for Children (January 1, 2005 to December 31, 2009). Subjects 19 years of age and younger who were evaluated in the emergency department and diagnosed with Lyme meningitis were eligible for inclusion as described previously [12]. Subjects without ECG testing were excluded. The Institutional Review Board of each participating center approved the study protocol with a waiver of informed consent.

**Study Definitions**

A case of Lyme meningitis was defined by a corrected cerebrospinal fluid (CSF) white blood cell (WBC) count of ≥10 cells/mm³ in conjunction with positive acute Lyme serologic tests or a physician-documented erythema migrans rash [5, 13]. To account for traumatic lumbar punctures, inclusion CSF WBC count was corrected for the presence of peripheral blood by subtracting CSF red blood cell count divided by 500 from the CSF WBC count [14, 15]. All specimens underwent two-stage testing; Western blot testing was performed only on specimens with a positive enzyme-linked immunosorbent assay. Positive Lyme titers were defined as demonstration of IgM and IgG antibodies to *Borrelia burgdorferi* in serum by Western immunoblot using published interpretive criteria of the reporting laboratory [5, 13]. Subjects with a positive *B. burgdorferi* IgM in the first 6 weeks of illness (despite negative IgG) were categorized as having Lyme meningitis, as this likely reflects developing host antibody response in early disseminated Lyme disease.

**Data Collection**

The complete hospital records of all study subjects were reviewed and elements of demographics, history, physical examination, clinical management, final diagnosis, pertinent laboratory data, and microbiologic results were abstracted into an electronic data collection form. ECG, echocardiogram, and myocardial biopsy results were collected for all subjects in whom these evaluations were performed. ECG interpretations were verified by board-certified pediatric cardiologists or electrophysiologists as part of routine clinical care.

**Outcome Measure**

The primary outcome measure was any electrocardiographic abnormality consistent with cardiac involvement of early disseminated Lyme disease [7]. Cases were defined as subjects with any of the following electrocardiographic changes consistent with Lyme carditis: AV block, ST-T wave changes, and prolongation of the QTc interval as previously described [7]. Controls were defined as subjects without ECG abnormalities associated with the cardiac manifestations of Lyme disease.

**Statistical Analysis**

Categorical variables were described using frequencies and percentages and compared using the χ² test. Continuous variables were described using median and interquartile range (IQR) values and compared using the Wilcoxon rank-sum test. An odds ratio (OR) and 95% confidence interval (CI) were calculated to evaluate the strength of any association, as well as the precision of the estimate of effect. Multivariable logistic regression was used to identify factors independently associated with ECG changes. Variables with a P value of <.20 on univariable analysis and observations in at least 85% of subjects were considered for inclusion in a multivariable model [16]. Continuous predictors were dichotomized for the multivariable analysis using clinically sensible breakpoints. These variables remained in the final model if they were statistically significant or if
their inclusion in the model resulted in confounding (i.e., 15% or greater change in the effect size of other model covariates) [16].

As ST-T wave changes may occur in otherwise healthy children, we conducted a subanalysis restricting the definition of carditis to those with either atrioventricular block or prolongation of the QTc interval. Multivariable logistic regression was repeated using this alternate definition to determine which variables remained significant predictors of carditis.

Statistical significance was determined a priori as a two-tailed \( P \) value <.05. All analyses were clustered by center using robust standard errors of Hubert and White. Predicted probabilities were calculated and reported with 95% CI.

RESULTS

During the study period, 157 children were diagnosed with Lyme meningitis. One hundred and three (66%) underwent ECG testing and were therefore included. Of the 103 patients with Lyme meningitis who had an ECG performed, 10 (10%) were diagnosed by the presence of physician-documented erythema migrans rash, 41 (40%) had both an erythema migrans rash and positive Lyme serology, and 52 (50%) had positive Lyme serology without an erythema migrans rash. Of the 93 children with positive Lyme serology, 3 had a positive IgM by Western blot, 41 had positive IgG, and 49 had positive IgM and IgG. The percentage of patients who had an ECG performed varied by center: 32 of 46 (70%) children at The Children’s Hospital of Philadelphia, 56 of 86 (65%) children at the Children’s Hospital Boston, and 15 of 25 (60%) children at Nemours/Alfred I. duPont Hospital for Children. The median age at presentation was 10.8 years (IQR: 7.6–13.2 years). Most (68%) of subjects were male and 85 (83%) presented between June and August (Table 1).

The median duration of illness was 14 days (IQR: 5–21 days) (Table 1). Approximately half of children had fever and a history of erythema migrans rash. Common presenting symptoms included headache and neck pain; 47 (46%) subjects had a cranial nerve palsy. Two subjects presented with seizures, and no subjects had swollen joints on physical examination. Two subjects complained of chest pain, which prompted performance of the ECG; no subject complained of dizziness, palpitations, or dyspnea. The median peripheral WBC count was \( 9.0 \times 10^3/\text{mm}^3 \) (IQR: 7.1–11.0 \( \times 10^3/\text{mm}^3 \)). Two subjects had CSF glucose concentrations of <40 mg/dL.

Thirty-four (33%) children had ECG abnormalities consistent with Lyme carditis. The prevalence of ECG abnormalities did not differ significantly between sites. Seven (20%) children had multiple ECG abnormalities (Table 2). The most common combination of abnormalities was first-degree AV block with ST-T wave changes, which occurred in 4 children. Other combinations included prolonged QTc interval with ST-T wave changes in 2 children, and first-degree AV block with prolonged QTc interval in 1 child. Seven subjects underwent ECG, and none had evidence of depressed myocardial function. No child had a myocardial biopsy performed. ECG abnormalities resolved or improved by hospital discharge in 20 (95%) of the 21 children for whom follow-up ECGs were available.

Children with ECG changes consistent with carditis were significantly older (median 13.0 years, IQR: 8.8–15.0 years) than children without ECG changes (median 9.0 years, IQR: 7.2–12.2 years, \( P = .01 \)) and also had significantly longer fever duration (median 3 days, IQR: 0–12.5 days) compared with children without ECG changes (median 0 days, IQR: 0–1 days, \( P < .01 \)) (Table 1). The CSF red blood cell count did not differ significantly between those with (median 8/mm\(^3\), IQR: 1–73/mm\(^3\)) and without (median 2/mm\(^3\), IQR: 1–6/mm\(^3\), \( P = .051 \)) ECG abnormalities. Differences in the CSF WBC count were also not statistically significant (Table 1). Age \( \geq 13 \) years, fever for \( \geq 5 \) days, and absence of headache were independently associated with carditis in the multivariable model (Table 3).

The predicted probability of having an abnormal ECG in subjects with specific clinical findings was calculated to facilitate clinical decision-making. The predicted probability of carditis was 55% (95% CI: 43–67%) for those with fever \( \geq 5 \) days and 58% (95% CI: 25–85%) for those age \( \geq 13 \) years. The 9 subjects who had fever for \( \geq 5 \) days and age \( \geq 13 \) years had a predicted probability of carditis of 83% (95% CI: 50–96%), placing them in a very high-risk category. Subjects with fever for \( < 5 \) days and age \( < 13 \) years were identified as having a low-risk of carditis with a predicted probability of carditis of 13% (95% CI: 8–20%); 50 subjects met these low-risk criteria.

When the definition of carditis was restricted to those with atrioventricular block or prolonged QTc, 26 (25%) children met criteria for having carditis. By this alternate definition, fever for \( \geq 5 \) days (adjusted OR: 4.78; 95% CI: 3.79–6.04) and age \( \geq 13 \) years (adjusted OR: 7.80; 95% CI: 1.54–39.40) remained significant predictors of carditis in multivariable analysis. The predicted probability of carditis for children with fever for \( \geq 5 \) days and age \( \geq 13 \) years, using this narrower definition, was 72% (95% CI: 35–92%). Subjects with fever for \( < 5 \) days and
age <13 had a predicted probability of carditis of 9% (95% CI: 8–10%); 78 subjects met these criteria.

Subjects with and without ECGs were compared to determine any differences between these two populations that would limit the generalizability of our results (Supplementary Appendix A). Subjects who underwent ECG testing were significantly more likely to have an erythema migrans rash compared with subjects who did not undergo ECG testing. The difference in the percentage of CSF mononuclear cells, while statistically significant, was clinically unimportant.

**DISCUSSION**

ECG abnormalities were common in this multicenter study of children with Lyme meningitis, occurring in approximately one third of subjects who had an ECG performed. While the prevalence of ECG abnormalities is thought to be low in subjects with Lyme disease, our study supports a higher risk of cardiac involvement in children with Lyme meningitis. Factors associated with carditis include older age and prolonged fever.

Previous studies have estimated the prevalence of Lyme carditis to be between 0.5% and 10%, depending on the Lyme disease stage [17, 20]. Gerber et al found that only 1 (0.5%) of 201 children with Lyme disease diagnosed in an outpatient setting and followed prospectively developed Lyme carditis [20]. In that study, of 4 children hospitalized with early-disseminated Lyme, 1 had carditis. Costello et al found that 33 (16%) of 207 children hospitalized with early disseminated Lyme disease had carditis; though the definition of meningitis was not specified, 16

### Table 1. Demographic, Clinical, and Laboratory Data for Subjects With Lyme Meningitis and Electrocardiogram Performed

<table>
<thead>
<tr>
<th>Variable Specified in Chart</th>
<th>All Subjects</th>
<th>No ECG Abnormality</th>
<th>ECG Abnormalities</th>
<th>Odds Ratio (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>103</td>
<td>70 (68)</td>
<td>45 (65)</td>
<td>25 (35)</td>
<td>1.48 (0.82–2.66)</td>
</tr>
<tr>
<td>Age ≥ 13 years</td>
<td>103</td>
<td>31 (30)</td>
<td>19 (53)</td>
<td>13 (19)</td>
<td>4.85 (1.24–18.94)</td>
</tr>
<tr>
<td>Clinical history</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of illness (days)</td>
<td>103</td>
<td>14 (5–21)</td>
<td>14 (7–21)</td>
<td>11 (5–18)</td>
<td>1.00 (1.00–1.01)</td>
</tr>
<tr>
<td>Fever</td>
<td>103</td>
<td>49 (48)</td>
<td>22 (65)</td>
<td>27 (39)</td>
<td>2.85 (2.07–3.92)</td>
</tr>
<tr>
<td>Fever ≥ 5 days</td>
<td>103</td>
<td>31 (30)</td>
<td>17 (50)</td>
<td>14 (20)</td>
<td>3.93 (2.29–6.75)</td>
</tr>
<tr>
<td>Absence of headache</td>
<td>102</td>
<td>13 (13)</td>
<td>5 (15)</td>
<td>8 (12)</td>
<td>1.26 (1.33–1.40)</td>
</tr>
<tr>
<td>History of erythema migrans</td>
<td>82</td>
<td>49 (60)</td>
<td>19 (70)</td>
<td>30 (55)</td>
<td>1.98 (1.02–3.83)</td>
</tr>
<tr>
<td>Photophobia</td>
<td>56</td>
<td>26 (46)</td>
<td>5 (31)</td>
<td>21 (53)</td>
<td>0.41 (0.11–1.49)</td>
</tr>
<tr>
<td>Neck pain</td>
<td>78</td>
<td>48 (62)</td>
<td>17 (61)</td>
<td>31 (62)</td>
<td>0.95 (0.24–3.80)</td>
</tr>
<tr>
<td>Joint pain</td>
<td>66</td>
<td>25 (38)</td>
<td>9 (41)</td>
<td>16 (36)</td>
<td>1.21 (0.39–3.77)</td>
</tr>
<tr>
<td>Physical examination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erythema migrans</td>
<td>103</td>
<td>35 (34)</td>
<td>14 (41)</td>
<td>21 (30)</td>
<td>1.60 (0.31–8.30)</td>
</tr>
<tr>
<td>Meningismus</td>
<td>100</td>
<td>25 (25)</td>
<td>10 (30)</td>
<td>15 (22)</td>
<td>1.51 (1.02–2.23)</td>
</tr>
<tr>
<td>Cranial nerve palsy</td>
<td>103</td>
<td>47 (46)</td>
<td>17 (50)</td>
<td>30 (43)</td>
<td>1.30 (0.71–2.38)</td>
</tr>
<tr>
<td>Papilledema</td>
<td>60</td>
<td>19 (32)</td>
<td>3 (16)</td>
<td>16 (39)</td>
<td>0.29 (0.08–1.04)</td>
</tr>
<tr>
<td>Leukocytosisa</td>
<td>103</td>
<td>60 (58)</td>
<td>21 (62)</td>
<td>39 (57)</td>
<td>1.24 (0.29–5.31)</td>
</tr>
<tr>
<td>Percent mononuclear cells</td>
<td>53</td>
<td>31 (24–40)</td>
<td>32 (16–41)</td>
<td>30.5 (23–40)</td>
<td>1.00 (0.98–1.02)</td>
</tr>
<tr>
<td>Elevated proteinb</td>
<td>103</td>
<td>54 (52)</td>
<td>18 (53)</td>
<td>36 (52)</td>
<td>1.03 (0.69–1.54)</td>
</tr>
<tr>
<td>White blood cell count</td>
<td>103</td>
<td>48 (29–99)</td>
<td>47 (29–98)</td>
<td>49 (29–99)</td>
<td>1.00 (1.00–1.00)</td>
</tr>
<tr>
<td>Percent mononuclear cells</td>
<td>102</td>
<td>92 (80–97)</td>
<td>92.5 (79–97)</td>
<td>91.5 (81.5–97.5)</td>
<td>1.00 (0.97–1.04)</td>
</tr>
</tbody>
</table>

The data have been stratified by the presence or absence of carditis. Abbreviations: ECGs, electrocardiogram; CI, confidence interval.

a White blood cell count >10 000/mm³.

b Cerebrospinal fluid protein concentration of > 43 mg/dL.

Values shown as number (percent) or median (interquartile range).

### Table 2. Prevalence of Electrocardiograph Abnormalities in Children With Lyme Meningitis

<table>
<thead>
<tr>
<th>Electrocardiograph Abnormality</th>
<th>Prevalence, No. (%)a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrioventricular nodal blockb</td>
<td>16 (16%)</td>
</tr>
<tr>
<td>Prolonged QTc interval</td>
<td>11 (11%)</td>
</tr>
<tr>
<td>ST-T wave changes</td>
<td>14 (14%)</td>
</tr>
</tbody>
</table>

a 7 subjects had multiple electrocardiograph abnormalities.

b All subjects with atrioventricular nodal block had first-degree atrioventricular nodal block.

### Table 3. Multivariate Model of Factors Associated With the Presence of Carditis Among Children With Lyme Meningitis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted Odds Ratio (95% Confidence Interval)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever ≥ 5 days</td>
<td>5.98 (3.72–9.61)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Age ≥ 13 years</td>
<td>6.95 (1.19–40.57)</td>
<td>.031</td>
</tr>
<tr>
<td>Absence of headache</td>
<td>1.44 (1.22–1.71)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
(12%) of those diagnosed with meningitis also had carditis [7]. In our study, we noted that 34% of children who had Lyme meningitis and who had an ECG performed had concomitant carditis.

Few studies have examined risk factors for Lyme carditis, and it is unclear whether children with Lyme meningitis are at higher risk of Lyme carditis than other children with early-disseminated Lyme disease. In a case-control study of 207 children hospitalized with early disseminated Lyme disease, arthralgias, age >10 years, and cardiopulmonary symptoms were found to be independently associated with carditis [7]. Although 48% of children with carditis also had meningitis, the presence of meningitis was not significantly associated with carditis. However, 40% of controls did not have an ECG performed. Therefore, children with Lyme meningitis and asymptomatic Lyme carditis may have been misclassified as controls, resulting in an underestimation of the prevalence of carditis in children with early disseminated Lyme disease. This misclassification would bias the study toward finding no association of meningitis and carditis (i.e., type II error).

In our study, age ≥13 years and fever duration of ≥5 days were independently associated with carditis. Although the overall prevalence of Lyme carditis in all children with Lyme meningitis is high, clinical decision-making should be guided by a higher level of suspicion for Lyme carditis in patients presenting with these predictive factors. We hypothesize that longer fever duration correlates with a longer duration of infection. Since it is thought that carditis is caused in part by invasion of the myocardium by the B. burgdorferi spirochete, a longer duration of infection may correlate with a higher likelihood of myocardial infiltration by the causative spirochete [4, 7, 21, 22]. The reason for the association of ECG abnormalities with older age is not known. While it is possible that older children tolerated the illness better and thus presented later, there was no significant association between age and duration of fever. The absence of headache was associated with ECG abnormalities in the primary analysis but not when the definition of ECG abnormalities was restricted to the subset of children with AV block or prolonged QTc interval, making the relevance of this finding unclear.

Although Lyme carditis is adequately treated by the intravenous antibiotic regimen recommended for Lyme meningitis [2], it is important to recognize Lyme carditis because requirements for continued hospitalization and cardiovascular monitoring can differ dramatically for those with and without concomitant carditis. Rapid fluctuations from first-degree heart block to complete heart block have been observed among children with Lyme carditis. All cases of heart block in our study were first-degree heart block. Although no patient in our study had an adverse outcome, 4 of 33 children with Lyme carditis reported by Costello et al [7] required transient transvenous pacing to treat complete heart block, and 1 child required cardiopulmonary resuscitation and extracorporeal membranous oxygenation. Current national guidelines recognize this risk of rapid changes in atrioventricular conduction and recommend that any subject with Lyme carditis and a PR interval of >300 msec or second- or third-degree heart block should be hospitalized for cardiovascular monitoring [2].

We identified specific subsets of children with Lyme meningitis who are at increased or decreased risk of Lyme carditis. For children who were either ≥13 years of age or presented with ≥5 days of fever, the risk of carditis was predicted to be >50%. The predicted probability increased to greater than 80% for children who fulfilled both of these criteria. Conversely, children <13 years of age who had fever for <5 days were unlikely to have carditis.

This study has several limitations. First, there may be referral bias. Although this was a multicenter study conducted in 3 states, enrollment was limited to tertiary care centers. Less severely ill children may seek care at community hospitals instead. While this limitation may lead us to overestimate the prevalence of carditis in children with Lyme meningitis, it should not affect factors predictive of Lyme carditis. Second, confounding is a potential limitation in any observational study. We minimized this effect by adjusting for confounders in our multivariate analysis. Third, only children who underwent ECG testing were included. Though the proportion of children undergoing ECG testing was comparable across centers, a clinician’s decision to obtain an ECG may have been related to the likelihood of carditis. This form of spectrum bias whereby high-risk children disproportionately undergo ECG testing would cause us to overestimate the true prevalence of carditis in this study. Fourth, some ECG abnormalities such as ST-T changes are nonspecific and occasionally occur in otherwise healthy children. To address this limitation, we conducted a subanalysis restricting the definition of carditis to only those with atrioventricular block and prolonged QTc interval. In this subanalysis, the prevalence of carditis remained high at 25% of children, and two of our clinical predictors (fever for ≥5 days and age ≥13 years) remained significantly associated with carditis. For those children who had repeat ECGs during the acute hospitalization, most of the identified abnormalities resolved. Finally, only children with Lyme meningitis were included...
in this study. The prevalence of ECG abnormalities may be different in children with other manifestations of Lyme disease such as facial nerve palsy.

In conclusion, independent predictors of ECG abnormalities in children with Lyme meningitis include age $\geq 13$ years and fever for $\geq 5$ days. The clinical consequence of such abnormalities, particularly in the absence of specific symptoms, is not known.

SUPPLEMENTARY DATA

Supplementary materials are available at The Journal of The Pediatric Infectious Diseases Society online (http://joids. oxfordjournals.org). Supplementary materials consist of data provided by the author that are published to benefit the reader. The posted materials are not copyedited. The contents of all supplementary data are the sole responsibility of the authors. Questions or messages regarding errors should be addressed to the author.

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Statement of data integrity. Dr Samir S. Shah had full access to all the data in the study and takes full responsibility for the integrity of the data and the data analysis.

Potential conflicts of interest. All authors: No reported conflicts.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest that the editors consider relevant to the content of the manuscript have been disclosed.

REFERENCES


